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SOME TESTS OF TOMATOES

By Leopoldo Bancain Uichanco

Thesis presented for graduation from the College of Agriculture No. 31.

Botany and History of the Tomato

The tomato belongs to the family *Solanaceae*, and to the genus *Lycopersicum* (meaning wolf-peach), which includes several species. The present work deals only with *L. esculentum* Miller.

The cultivation of tomatoes is said to extend as far back as three hundred years or more(1). It was not, however, till the last thirty to fifty years that this plant was improved and the garden races established through systematic selection and breeding. De Candolle(2) ascribes the origin of the tomato, or at least its earliest cultivation, to Peru. So far as evidence shows, the plant did not find its way to the Old World till after the discovery of the New. Its relationship to the nightshade led people to believe that the plant was poisonous; and in North America, where it was so near its original home, the tomato did not find its way to the table till the latter part of the eighteenth century two hundred years after it had come to the attention of botanists. Italy and Spain were the first countries in Europe where the tomato became generally used for table purposes(3). It was not till the past century that this plant was cultivated in China and Japan.

Characters, Varieties and Types

There are several types of tomatoes in existence, the principal ones being the pear, the plum the cherry, the peach and the commercial. The color varies from pale yellow, to red, deep crimson, and even violet. Of varieties there is an endless number and many of them resemble each other so closely that it is frequently hard to distinguish one from another. The plants differ in stature, some varieties being scarcely three decimeters tall, while others attain a height of one meter or more.

The tomato lends itself to a great variety of uses. In medicine it it said to be a remedy for liver complaint(1). As a food, no table is complete without it. Salads, tomato soup, sauce, ketchup, pickles, sweetmeat, mincemeat, and relish are all familiar examples of the uses of the tomato as food. A good kind of wine can also be prepared from tomatoes. An edible oil can be expressed from the seeds and a fair grade of wrapping paper can be manufactured from the skins(2).

During the past few years horticulturists have interested themselves in breeding tomatoes in an effort to produce an ideal commercial strain, and their efforts have been crowned with remarkable success, as may be seen from the excellent types of commercial tomatoes now sent out by seed houses. An ideal tomato possesses the following characteristics:—

(1) Bailey, "Cyclopedia of American Horticulture."
(2) De Candolle, "Origin of Cultivated Plants."
(3) Bull. 239, Univ. of Cal.

(1) *The Tropical Agriculturist*, Vol. I, No. 5.
(2) *Bull. Soc. Sci.*, No. 56, G. Rovesti.

1. It is without a depression at the stem end. (A fruit with a depression necessarily loses too much in peeling.)

2. It is round in shape, without ridges.

3. Its interior is well formed and compact.

4. It is of medium size, growing in large clusters.

5. Its first flowers appear as near the roots as possible, generally at about the ninth or tenth nodes.

6. For canning a fruit is required of a uniform bright red color, persisting unchanged during the preserving processes.

The Tomato Industry in the Philippine Islands

General Remarks.—It is believed that the early Spanish colonizers introduced the commercial type of tomato in the Philippine Islands. The galleon trade, instituted by the colonial government of Spain between Mexico and the Philippines, added to the horticultural wealth of this country a collection of valuable ornamental and economic plants; and in all probability the tomato, which at an early date became a common garden plant in Mexico, was one of these introduced exotics. The Catholic *padres*, too, who came by way of Mexico, must have been more or less responsible for the introduction of tomatoes in these Islands. China and Japan knew this country long before Magellan's ships first anchored at Malhon; and from time immemorial Chinese and Japanese merchants have found here a market for their silk goods and other products. Chinese gardeners have established themselves and pursued their vocation in many different parts of the Archipelago, planting vegetables and fruits in their gardens. But neither China nor Japan could have claimed the honor of introducing tomatoes in the Philippine Islands, because the tomato was unknown in both these two countries till sometime during the past century.

The origin of the wild type of tomato, as it occurs here, seems to be obscure. It appears to be pantropical.

Distribution.—The vicinity of Manila is necessarily the largest tomato growing region in the Philippine Islands. It is only in Pasig and in Mariquina, (both towns in the province of Rizal), in Santa Cruz (La Laguna), and in some towns of Batangas province that tomatoes are grown on a large scale. In Vigan, Ilocos Sur, some tomatoes are grown to supply the local demand and that of neighboring places. If the information given by students in the College of Agriculture from different parts of the Archipelago may be taken as correct, tomatoes, in other provinces, are planted only in yards about houses, and never on a large commercial scale.

Pasig and neighboring places grow the most tomatoes, and are the oldest of all tomato-growing regions of the Philippine Islands. Their tomatoes have the reputation of being larger, finer, and sweeter than those grown in near-by provinces. This may more reasonably be ascribed to the quality of the soil and other conditions in the locality than to the inherent characteristics of the Pasig variety. In support of this view it must be noted that the tomatoes now grown in Santa Cruz are descendants of those in Pasig; and Pasig tomatoes look and taste better than those of Santa Cruz.

In December, 1914, there was not much tomato-growing in the town of Pasig, due to the destruction of most of the fields by the floods which occurred during the previous rainy season. There were small tomato fields in the *barrios* of Kaniugan, Ugong, and Palateo. The largest of these had an area of less than half a hectare.

In Mariquina more and better tomatoes were then being grown than in Pasig. It may be mentioned in passing that almost all the agricultural lands in Mariquina are owned by the Tuason brothers, of Manila, and are apportioned among tenants on the condition that they handle the land properly. Failure to comply with the regulations of the owners will result in the transfer of the land to another individual. As a result, all the fields visited were in good tilth and almost no weeds could be found growing among the plants. The majority of the fields, especially those lying along the banks of the Mariquina river, were planted to tomatoes, frequently alternated at every third row with a row of corn. At certain places radishes, sincamas (*Pachyrrhizus erosus L.*), amargoso (*Momordica balsamina*), and garden peas were planted in patches between tomato fields.

The soils in Pasig and Mariquina are for the most part composed of alluvial loam deposited by the Pasig and Mariquina rivers during their yearly inundations. The surface soil in most of the places visited in Pasig and in Mariquina is about one and a half decimeters in depth, and consists of sandy loam, light-colored, very friable, smooth and slippery to the touch, like dry talcum powder. The subsoil is denser and harder in texture; but does not differ much from the surface soil in mechanical consistency.

In Santa Cruz the soil is a very sandy loam. Like the Pasig and Mariquina soils, those of Santa Cruz are for a part of the year covered with water from Laguna de Bay, which on withdrawal leaves a thick coat of rich alluvial soil. The presence of a great number of earthworms crawling over the surface when the ground is moist may be taken as an indication of the presence of a considerable amount of organic material, which may have attracted them.

The tomato season in the region around Manila begins about November (from seeds planted the latter part of July or the beginning of August), reaches its height in January or February and ends about March. At other times of the year tomatoes are exceedingly scarce in the market. During such times it is not rare to see culls, which are no bigger than the common plum variety, and which are pale and contain almost no juice, sold for two centavos(1) apiece. These fruits are gathered from plants grown about houses, as no farmer will attempt to raise tomatoes on a large scale at times other than in the usual tomato season. His experience has shown him that tomatoes not planted at the proper time are very unproductive, only one or two and sometimes no fruits being produced by each plant; and when fruits are produced, they are almost sure to be culls.

Native Methods of Tomato Culture.—The seeds are sown on beds prepared in one corner of the field. Nursery flats are practically unknown among the farmers. In about a month's time the seedlings are ready for permanent transplanting in the field. The plants are pulled out of the seed bed and, after washing the roots carefully, are set out. Not much attention is given in the way of cultivation and irrigation. Neither prunning nor training is practiced; in fact the vines are allowed to grow as freely as they will. The fruits are gathered once a week, at the beginning of the season, and later twice a week. The more industrious planters go over the field once or twice a week and pick out all the fungus, and insect-infested fruits and carry them out to be burned or buried. Seed selection is practiced to some extent, though not systematically. Only round fruits from profusely bearing plants are used for seeds.

Tomato growing in the Philippines is at present a game of chance, from a financial point of view. During certain parts of the tomato season, at a time which is very variable, it really pays to raise tomatoes. The writer personally knows at least three farmers who have become wealthy from tomato growing. During good times the grower finds no difficulty in disposing of his product, at a good price. The merchant comes even before the plants begin to flower and engages to gather the season's crop, fixing a certain price for the harvest in advance. In Mariquina the writer was informed by the planters that the price offered for the crop of a certain field is based on the number of plants growing thereon, the amount ranging from two to five centavos per plant. This practice, unfortunately much in vogue among tomato planters, is objectionable in that the farmers are tempted to plant as closely as they can, even to the extent of overcrowding the plants, thus lowering the size and quality of the fruits.

There are other times, when tomatoes are so plentiful that the market is overstocked, the supply far exceeding the demand. Then tomatoes have practically no money value. Big loads are sent from Santa Cruz or from Pasig only to find the stalls of the Manila markets too full to receive any more, and no other place is left for the cargoes than the garbage heaps of the city. At such a time as this, thrifty housewives can go to a tomato field and help themselves to as many tomatoes as they want without fear of having to account for what they get.

Another point that demands consideration is the method of handling the harvested fruits in transit. Here the inferiority of local methods is again very noticeable. The native tomatoes are generally ridged, and curled at the two ends, creating thus a much greater free space in the containers than the ideal round, smooth fruits. Again, the tomatoes here are very seldom sorted. Some unscrupulous dealers even intentionally place all the culls and deformed tomatoes at the bottom of the container, placing at the top a layer of beautiful, large-sized fruits, and attempt to let the whole case pass for first class goods. To the nondiscriminating local buyer this will probably not make much difference; but if we are to handle an export trade, and expect to win over competitors from abroad, this evil ought to be remedied.

The container, called *kaeng*, used in transporting tomatoes, a large, rigid basket or hamper wider at the top than at the bottom, also allows too much free space. The only advantage of this container is its cheapness, the cost being twenty centavos each; and the *kaengs* can be

(1) One centavo = $0.005; one peso = $0.50, U. S. currency.

nested when empty and sent back to be refilled. Otherwise, boxes are more appropriate for use as containers.

Tomato Canning.—Canning would be the best and most efficient means for saving the surplus tomatoes of such abundant crops. It is of itself an industry which demands careful planning and consideration on the part of any one contemplating going into the business. Canning on a commercial scale has never been attempted in the Philippine Islands, and it will not be safe to predict its outcome until after a trial has been made. At Pinelands, Cabanatuan, province of Nueva Ecija, the Philippine Pineapple Company (incorporated 1912) is installing a modern and up-to-date factory for canning pineapples, roselle, mangoes and tomatoes. It is expected that the factory will be in operation next July. According to the information received by the writer from L. C. Kellogg, general manager of the company, the factory building measures 76 ft. x 120 ft. and is made wholly of iron. The cost is ₱6,-000.00. The machinery, including the can-making accessories, is worth ₱24,000.00. The one-unit machine, that the company was installing at the time that Mr. Kellogg wrote (December 7, 1914), has a capacity of 8,000 cases per month (24 cans to the case). Six more units will be added, which will bring the total capacity of the machine to 60,000 cases per month. When the factory comes into actual operation and reliable data can be obtained, we shall then be in a position to decide whether or not a canning industry can be made a successful enterprise in the Philippine Islands.

Tomato growing is a pleasant and healthful occupation and one in which even school girls may profitably engage during their spare hours. An equipment costing from ₱15.00 to ₱20.00 will enable girls to earn pocket money easily by canning tomatoes at home. Home made tomato foods have met with much popularity in the United States, and there is no doubt that there will also be a growing demand for such products in this country(1).

Factories in America and in Europe are now marketing their canned tomatoes and preserved tomato products throughout the world. We pay high prices for their products; and a can which contains no more than two good sized tomatoes is sold for fifteen centavos, while fresh tomatoes sell here at the rate of ten to twenty for one centavo during the height of the tomato season. As to the commercial side of the tomato canning industry, the manager of the Pacific Commercial Company has furnished the following information: "The common size of cans used in canning tomatoes is No. 2½, containing about 30 ounces net of tomatoes. This is called the 'standard tomato.' This particular grade has the biggest trade here and wholesales for from ₱3.80 to ₱4.30 a case of 24 cans. This comprises the quality of tomato that can not be put in the first grade, known as 'solid pack,' and includes those that are broken and free from peelings. Solid pack tomato is absolutely whole and the price is about one peso a case more. There is also the Spanish tomato packed in 1 and ½ lb. cans, best known as the Trevijano.

"The cheapest tomatoes come from the east coast of the United States, chiefly from Maryland. The cans used for packing are No. 2 and No. 3. A No. 2 can has 6 ounces less and a No. 3, 6 ounces more than a No. 2½. The cost of tomatoes from the East is about ₱0.70 a case less than those from the Pacific Coast.

"The tomato season in California begins about the 20th of August, is at its height from about the 10th of September till about the 25th of October, and ends about the 25th of November. The 'standard tomato' sells for from ₱1.40 to ₱1.70 per dozen cans. There are always 24 cans to the case in all sizes of American tomatoes."

That the tomato-canning industry is proving to be profitable in the United States is shown by the following excerpt from a leaflet published by the Northwestern Steel & Iron Works, entitled *Profits of the Canning Business, Verifying Results Obtained in Using the National Pressure Canning Boilers:*

"At Monroe, Michigan, located in the southeastern county of the State, the results on tomatoes were as follows, from 2½ acres (1 hectare) of land:

Rent of land @ $6 per Acre	$ 15.00
Ploughing and cultivating	6.25
Plants	13.12
Fertilizer	10.75
Setting plants	2.25
Gathering tomatoes	23.00
10,656 No. 3 cans @ $18.50 per M	196.80
Labor hire in canning	48.24
Cases	40.20

(1) A number of bulletins have appeared dealing with the subject of the home canning of vegetables. The most recent is Bull. 82, Idaho Ag. Exp. Sta., Moscow, Id. 1915.

Fuel	4.15
Solder, acid, etc	7.75
Labels	21.31
Labeling and casing	10.01
Total cost	$398.83
Sold 887 dozen cans of finished goods @ 95c. per dozen	$842.65
Less total cost	$398.83
Net gain	$443.82

"The goods in this case were sold direct to retailers and brought 10c. more per dozen than could have been obtained from the jobbers, besides in several instances were delivered without cases, saving that expense."

There is no secret involved in the canning business. Success lies mainly in enclosing, in the most efficient and economical way, the completely sterilized fruits so as to keep them absolutely inaccessible to germs of decay. There is no reason why, with the proper kind of apparatus, the canning of fruits and vegetables can not be successfully carried out in this country, where the supply of raw material is so abundant, the labor so cheap as compared with what of many other countries, and where fuel can be secured at little cost. Great sums of money are unnecessarily sent out of these Islands for the importation of products which can just as well be prepared here. It is a disgrace that we should have to depend for our supplies on countries where, due to adverse climatic conditions, tomatoes can be grown at times only by forcing them under glass at great expense and labor, and which process can entirely be dispensed with in this country. There are times when the tomato here grows and produces abundantly after being stuck in the ground and left to fight its own way with practically no aid from man. With conditions so favorable as this we ought to expect not only to raise enough for our own use; but also to be able to manage affairs in such a way as to change the commercial current by exporting, instead of importing, tomatoes.

Acclimatization Tests with Imported Varieties

American and European horticulturists are growing tomatoes that approach, if not exactly satisfy, the requirements of the ideal type. An endless number of varieties exists; many have proven to be valuable plants in the countries where they are growing. But, like other plants which for generations have grown in a temperate country and have adapted themselves to the conditions of a temperate climate, tomatoes newly introduced in a tropical region, no matter how successful they might have been in their former home, may usually be expected to do less well at the beginning. Only by degrees can the plants be made to adapt themselves to their new environment, although satisfactory results may be obtained after a number of generations. It is always possible that out of the great number of existing varieties, certain ones will do well from the very first.

A variety which may fail in one season of the year may prove to be a decided success in another. In order to determine the time of the year best suited to each variety we have made it a point in the present work to plant all the foreign varieties obtainable, at regular intervals of two months, beginning on the 29th of November 1913. As far as practicable, a uniform method of handling the plants, in the whole series of acclimatization experiments, was adopted in order to have a fair basis for comparison. Their behavior each season was observed by measuring the weekly growth of each variety, since growth may oftentimes be taken as a more or less reliable indicator of the thriftiness of a plant, the total increase of the length of a main branch being noted, the weight of ripe fruit produced was also made a matter of record.

The following varieties were used; (the number prefixed to each is the record number in the Department of Agronomy):—

From Sutton & Sons, London: 2376, Frogmore selected; 2377, Cascade; 2378, Perfection; 2379, Golden Nugget; 2380, The Trophy; 2381 Peachblow; 2382, Sunbeam; 2383, Abundance; 2384, Dessert; 2385, Winter Beauty; 2386, Golden Queen; 2387, A-1; 2388, Golden Perfection; 2389, Early Market; 2390, Satisfaction; 2391, Peachblow.

From Vilmorin-Andrieux, Paris: 2426, Prince Borghèse; 2428, Rouge naine hâtive; 2429, Ponderosa écarlate; 2430, Chemin rouge hâtive; 2431, Reine des Hâtives; 2432, Rouge à tige raide de Laye; 2433 Rouge grosse hâtive; 2434, Roi Humbert; 2435, Rouge grosse; 2436, Trophy, rouge grosse lisse; 2437, Perfection; 2438, Champion écarlate; 2439, Mikado écarlate; 2440, Trés hâtive de pleine terre; 2441, Merveille des Marches; 2447, Perdrigon.

In addition to the above list we used seeds of the Santa Cruz variety, a native tomato, to serve as a check. Table I shows the average weekly growth, and Table II the average yield of each variety in each set.

The plants were allowed to remain at least five months on the land, when they were cleared off if found to be unproductive. There were six sets of the different varieties under consideration, planted at intervals on dates enumerated in Tables 1 and 2.

TABLE I.

AVERAGE WEEKLY GROWTHS (in mm.)

Week Ending	*Var. 2376*	*Var. 2377*	*Var. 2378*	*Var. 2379*	*Var. 2380*	*Var. 2381*	*Var. 2382*	*Var. 2383*	*Var. 2384*
		SET 1. PLANTED NOVEMBER 29, 1913.							
24- I-14	51	19	37	19	11	17	51	20	53
31- I-14	55	22	53	30	30	43	60	36	61
7- II-14	61	41	51	48	47	62	72	49	50
14- II-14	71	61	64	57	54	75	85	58	59
21- II-14	42	51	64	36	53	66	85	36	98
28- II-14	50	57	60	55	61	70	68	66	44
7-III-14	58	67	68	49	72	42	58	58	42
14-III-14	23	48	32	40	27	22	37	60	35
Gen. Av.	54	46	54	42	44	50	65	48	55
		SET 2. PLANTED JANUARY 29, 1914.							
28- III-14	67	45	54	60	68	48	58	53	51
4- IV-14	76	50	56	50	71	55	56	57	48
11- IV-14	96	83	86	33	72	68	70	94	79
18- IV-14	178	193	117	—	159	103	183	70	76
25- IV-14	100	92	104	47	109	68	76	100	88
2- V-14	82	63	96	54	96	74	56	104	47
9- V-14	81	109	82	37	86	61	51	62	168
Gen. Av.	97	91	85	64	94	68	54	77	80
		SET 3. PLANTED MARCH 30, 1914.							
30- V-14	46	—	56	60	—	38	64	—	42
6- VI-14	51	—	48	56	—	68	64	—	59
13- VI-14	98	—	79	138	—	96	117	—	73
20- VI-14	101	—	110	114	—	119	132	—	100
27- VI-14	84	—	58	115	—	47	63	—	105
Gen. Av.	76	—	70	97	—	74	88	—	76
		SET 4. PLANTED MAY 29, 1914.							
25- VII-14	31	57	53	40	27	—	31	32	43
1-VIII-14	41	81	54	53	44	—	35	30	54
8-VIII-14	66	112	93	78	43	—	40	61	70
15-VIII-14	94	129	106	72	67	—	64	61	86
22-VIII-14	135	93	127	124	47	—	94	113	124
29-VIII-14	139	—	107	127	97	—	70	76	73
5- IX-14	69	62	82	70	34	—	63	62	55
Gen. Av.	82	89	89	81	45	—	57	62	72
		SET 5. PLANTED JULY 29, 1914.							
3-X-14	74	—	—	—	—	75	—	—	38
10-X-14	76	—	—	—	—	58	—	—	57
17-X-14	80	—	—	—	—	116	—	—	106
24-X-14	75	—	—	—	—	156	—	—	61
Gen. Av.	76	—	—	—	—	101	—	—	66
		SET. 6. PLANTED OCTOBER 8, 1914.							
23- XI-14	—	55	—	84	—	—	38	—	174
1-XII-14	—	70	—	117	—	—	92	—	89
8-XII-14	—	95	—	132	—	—	117	—	140
12-XII-14	—	—	—	—	—	—	—	—	—
19-XII-14	—	174	—	156	—	—	115	—	174
Gen. Av.	—	98	—	122	—	—	141	—	144

TABLE I—Average Weekly Growths (in mm.)—Continued

Week Ending	Var. 2385	Var. 2386	Var. 2387	Var. 2388	Var. 2389	Var. 2390	Var. 2391	Var. 2426	Var. 2428
Set 1. Planted November 29, 1913.									
24- I-14	86	32	37	26	45	29	45	21	37
31- I-14	54	51	67	51	86	44	51	43	59
7- II-14	69	59	78	57	89	61	61	51	62
14- II-14	89	63	77	60	103	73	69	56	62
21- II-14	58	73	84	59	70	81	51	72	54
28- II-14	48	48	82	62	77	74	68	87	41
7-III-14	51	118	47	58	56	61	21	43	40
14-III-14	48	27	37	44	47	21	31	38	31
Gen. Av.	63	59	63	52	72	56	79	51	47
Set 2. Planted January 29, 1914.									
28-III-14	62	45	59	—	75	52	29	34	36
4- IV-14	68	46	71	—	76	45	47	55	25
11- IV-14	92	75	85	—	77	90	75	71	35
18- IV-14	129	115	193	—	164	115	71	110	83
25- IV-14	101	76	63	—	85	110	89	75	63
2- V-14	79	73	95	—	107	57	80	24	55
9- V-14	66	63	145	—	171	77	94	67	30
Gen. Av.	85	71	93	—	108	78	69	62	47
Set 3. Planted March 30, 1914.									
30- V-14	—	—	—	—	—	44	41	—	18
6-VI-14	—	—	—	—	—	59	33	—	31
13-VI-14	—	—	—	—	—	107	68	—	45
20-VI-14	—	—	—	—	—	133	78	—	72
27-VI-14	—	—	—	—	—	112	65	—	73
Gen. Av.	—	—	—	—	—	91	57	—	48
Set 4. Planted May 29, 1914.									
25- VII-14	6	43	—	27	51	46	24	25	—
1-VIII-14	24	40	—	39	57	60	37	48	—
8-VIII-14	8	65	—	47	88	92	91	55	—
15-VIII-14	39	97	—	62	85	116	80	65	—
22-VIII-14	60	88	—	112	112	153	110	122	—
29-VIII-14	50	69	—	88	58	118	90	60	—
5- IX-14	43	65	—	62	59	72	75	75	—
Gen. Av.	32	67	—	62	73	94	72	64	—
Set 5. Planted July 29, 1914.									
3-X-14	—	—	—	—	79	—	39	46	—
10-X-14	—	—	—	—	96	—	109	87	—
17-X-14	—	—	—	—	80	—	99	4	—
24-X-14	—	—	—	—	168	—	108	11	—
Gen. Av.	—	—	—	—	106	—	88	37	—
Set 6. Planted October 8, 1914.									
23- XI-14	—	—	—	—	—	—	—	—	55
1-XII-14	—	—	—	—	—	—	—	—	75
8-XII-14	—	—	—	—	—	—	—	—	98
12-XII-14	—	—	—	—	—	—	—	—	—
19-XII-14	—	—	—	—	—	—	—	—	61
Gen. Av.	—	—	—	—	—	—	—	—	72

TABLE I—Average Weekly Growths (in mm.)—Continued

Week Ending	Var. 2429	Var. 2430	Var. 2431	Var. 2432	Var. 2433	Var. 2434	Var. 2435	Var. 2436
			Set 1. Planted November 29, 1913.					
24- I-14	10	36	15	4	26	38	29	31
31- I-14	22	47	29	4	39	52	33	57
7- II-14	36	69	36	5	45	68	39	71
14- II-14	50	65	47	5	40	69	40	71
21- II-14	57	63	50	10	57	86	40	79
28- II-14	73	69	62	12	54	73	56	73
7-III-14	51	54	60	12	27	96	42	50
14-III-14	54	45	43	4	20	36	34	31
Gen. Av.	88	56	43	7	38	65	39	58
			Set 2. Planted January 29, 1914.					
28-III-14	53	66	72	18	45	57	53	69
4- IV-14	54	77	56	18	54	65	41	83
11- IV-14	87	72	111	19	59	72	42	77
18- IV-14	103	64	107	9	102	105	66	149
25- IV-14	95	117	98	27	78	83	63	111
2- V-14	73	85	93	27	78	123	45	85
9- V-14	99	84	88	30	92	84	59	155
Gen. Av.	81	81	90	21	73	84	53	104
			Set 3. Planted March 30, 1914.					
30- V-14	67	—	42	—	—	47	29	30
6-VI-14	55	—	38	—	—	44	38	48
13-VI-14	80	—	51	—	—	77	52	71
20-VI-14	103	—	44	—	—	118	75	113
27-VI-14	65	—	72	—	—	91	80	70
Gen. Av.	74	—	50	—	—	75	55	66
			Set 4. Planted May 29, 1914.					
25- VII-14	—	30	59	—	—	25	53	32
1-VIII-14	—	32	58	—	—	32	37	53
8-VIII-14	—	37	74	—	—	66	58	71
15-VIII-14	—	65	102	—	—	60	89	73
22-VIII-14	—	80	153	—	—	95	95	100
29-VIII-14	—	99	74	—	—	52	51	56
5- IX-14	—	63	64	—	—	52	57	62
Gen. Av.	—	81	83	—	—	55	63	61
			Set 5. Planted July 29, 1914.					
3-X-14	—	30	—	—	66	78	—	74
10-X-14	—	40	—	—	75	91	—	89
17-X-14	—	67	—	—	71	99	—	106
24-X-14	—	96	—	—	61	146	—	103
Gen. Av.	—	58	—	—	68	101	—	93
			Set 6. Planted October 8, 1914.					
23- XI-14	—	—	57	11	24	77	—	—
1-XII-14	—	—	103	20	40	124	—	—
8-XII-14	—	—	145	32	64	164	—	—
12-XII-14	—	—	—	—	—	—	—	—
19-XII-14	—	—	145	27	117	185	—	—
Gen. Av.	—	—	110	22	61	137	—	—

TABLE I—Average Weekly Growths (in mm.)—Continued

Week Ending	Var. 2437	Var. 2438	Var. 2439	Var. 2440	Var. 2441	Var. 2447	Santa Cruz.
Set 1. Planted November 29, 1913.							
24- I-14	12	30	24	32	39	30	—
31- I-14	26	58	46	50	49	44	24
7- II-14	35	63	41	62	66	41	48
14- II-14	47	48	43	73	76	52	67
21- II-14	41	42	41	56	82	49	64
28- II-14	55	38	39	56	98	52	73
7-III-14	55	30	33	48	81	36	44
14-III-14	41	30	30	37	64	33	41
Gen. Av.	39	42	34	52	69	40	51
Set 2. Planted January 29, 1914.							
28-III-14	54	19	48	60	50	56	68
4- IV-14	65	16	85	53	52	61	65
11- IV-14	100	22	51	85	75	59	81
18- IV-14	117	48	100	112	108	81	70
25- IV-14	101	44	56	89	84	56	65
2- V-14	83	39	55	84	98	54	37
9- V-14	99	19	63	113	92	45	71
Gen. Av.	88	30	65	85	80	59	58
Set 3. Planted March 30, 1914.							
30- V-14	52	—	—	30	—	—	—
6-VI-14	56	—	—	29	—	—	—
13-VI-14	81	—	—	58	—	—	—
20-VI-14	89	—	—	81	—	—	—
27-VI-14	49	—	—	40	—	—	—
Gen. Av.	65	—	—	48	—	—	—
Set 4. Planted May 29, 1914							
25- VII-14	29	—	—	31	34	47	50
1-VIII-14	31	—	—	28	41	38	59
8-VIII-14	62	—	—	38	65	67	45
15-VIII-14	56	—	—	57	83	73	100
22-VIII-14	63	—	—	78	112	89	167
29-VIII-14	35	—	—	71	70	71	51
5- IX-14	58	—	—	105	72	65	48
Gen. Av.	47	—	—	55	68	64	74
Set 5. Planted July 29, 1914.							
3-X-14	81	68	—	—	5	—	84
10-X-14	135	54	—	—	21	—	105
17-X-14	177	78	—	—	—	—	112
24-X-14	—	65	—	—	—	—	162
Gen. Av.	131	66	—	—	13	—	116
Set 6. Planted October 8, 1914.							
23- XI-14	—	—	—	—	34	—	77
1-XII-14	—	—	—	—	77	—	112
8-XII-14	—	—	—	—	114	—	111
12-XII-14	—	—	—	—	—	—	—
19-XII-14	—	—	—	—	148	—	207
Gen. Av.	—	—	—	—	93	—	126

TABLE II.

TOTAL YIELD PER SET PER PLANT

Variety Number:	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6
2,376	0	0	0	0	0	—
2,377	220	112	—	112	—	865
2,378	0	0	0	0	—	—
2,379	80	30	10	40	—	616
2,380	0	0	—	0	—	—
2,381	0	0	0	—	0	—
2,382	0	0	0	18	—	134
2,383	0	0	—	0	—	—
2,384	50	30	12	280	320	1489
2,385	0	0	—	0	—	—
2,386	0	0	—	0	—	—
2,387	0	0	—	—	—	—
2,388	0	—	—	0	—	—
2,389	0	0	—	0	0	—
2,390	0	0	0	0	—	—
2,391	0	0	0	0	0	—
2,426	0	0	—	149	240	—
2,428	0	0	0	—	—	0
2,429	0	0	0	—	—	—
2,430	0	0	—	0	0	—
2,431	0	0	0	0	—	235
2,432	0	0	—	—	—	0
2,433	0	0	—	—	0	120
2,434	0	0	0	168	320	536
2,435	0	0	0	0	—	—
2,436	0	0	0	0	40	—
2,437	0	0	0	0	0	—
2,438	0	0	—	—	0	—
2,439	0	0	—	—	—	—
2,440	0	0	0	0	—	—
2,441	0	0	—	129	92	155
2,447	0	0	—	0	—	—
Santa Cruz	90	80	—	72	172	285

NOTE: All weights given in this table are in grams. A dash (—) means that no plant in the set lived on which to base the yield of the variety in question.

Results.—In each of the sets the different varieties of plants behaved very differently, both in rate of growth and in production. Many of the imported varieties failed entirely in the tests. The varieties that bore fruit in one or all of the tests wherein they were included were: 2384 Sutton's Dessert; 2379 S. Golden Nugget; 2377 S. Cascade; 2426 Vilmorin-Andrieux's Prince Borghèse; and 2434 V. A. Roi Humbert—all of the small varieties. Of the commercial types—2382 Sutton's Sunbeam; 2436 Vilmorin-Andrieux's Trophy, rouge grosse lisse; 2441 V. A. Merveille des Marches; 2431 V. A. Reine des Hâtives; and 2433 V. A. Rouge grosse hâtive. The fruits of the commercial forms were only about one-half as large as, or even less than one-half, the size they attain in their original homes, judging from the descriptions in the catalogues sent out by the establishments from which the seeds were secured.

The following facts were obtained from the measurements of weekly growth:

1. In a week having no rain at all, following weeks of very little or no precipitation (ranging from 0 to 0.17 in.) the growth is very slow. For example, in the week ending March 14, 1914, which followed four weeks in which the rainfall was 0.07 in., 0.17 in., and 0.5 in. respectively, the average weekly growth for that week ranged from 20 mm. to 64 mm., only in the faster growing varieties and was only 4 mm. in Rouge à tige raide de Laye, a slower-growing variety.

2. A period of sunshine with little or no rainfall, following a period of rain, results in an increase of growth. Example: In a week ending February 14, 1914, the rainfall was 0.51 in.; during the previous weeks, 0.12 in., 0.31 in., and 1.07 in. The growth during that week ranged from 40 to 103 mm., against the 10 to 89 mm. of the preceding weeks in the case of the faster growing varieties, and the growth increased from 4 mm. in the previous weeks to 10 mm. in the week under consideration in the case of Rouge à tige raide de Laye.

3. A week of continuous heavy rainfall results in the retardation of growth. In the week ending September 5, 1914, when there was a heavy rain daily, the total precipitation amounting to 17.40 inches for the whole week, the growth dropped from the weekly average of 50 mm. to 139 mm., to an average of from 34 mm. to 105 mm.

4. A period of light rain following a period of sunshine results in an increase in growth. In the week ending April 18, 1914, when it rained for three days, the total rainfall amounting to 2.15 inches, the maximum growth was 193 mm., as compared with the maximum growth of 85 mm. in the week ending April 4, when the rainfall was 0, and with the maximum growth of 101 mm. in the week ending April 11, when the rainfall was 0.05 inches, or almost 0.

5. The season when the general average for all the weekly growths is greatest, is, because of the excellent constitution of the plant, to be looked upon as the time when the plant in question will be most productive. Examples: 2434 Roi Humbert gave an average growth of 137

(*Continued on page 70*)

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A New Asset of the Tobacco Industry in the Philippines

The College of Agriculture is well enough known, as an institution for the training of farmers, but its work in the way of experimentation has often been overlooked. It has not been considered as an experiment station, though for years past it has been that in fact, as indicated by its results. The theses of graduating students, published from month to month in this Journal, deal with the solution of problems that concern practical agriculture. In the accompanying letter from the "Germinal," one of the leading tobacco factories in the Philippines, we find an unsolicited acknowledgement of the work of one of our students. They recognize the value of a new tobacco hybrid, a cross of the Connecticut Broadleaf and the Cagayan, which makes a good wrapper. This was the result of the thesis work of Mr. Jose Tirona, who graduated from the College of Agriculture in 1914. The thesis was published in Volume III, No. 1, of this paper.

The letter has been written in acknowledgement of the cured samples of tobacco sent by the Agronomy Department to ascertain their value. They consisted of Tirona hybrid, Turkish Lowland, Sumatra, and Vuelta Abajo, which were raised and cured by the Agronomy III class, the latter part of the year 1914-1915, under conditions that were not at all favorable, but still gave fair results.

The hybrid referred to is now in the second generation. The fact that excellent results were obtained under rather unfavorable climatic conditions in a region that is not best adapted to tobacco culture, speaks for a bright prospect. Its culture in other parts of the country where tobacco is at home is worth trying.

This new cross has an important bearing on the tobacco industry of the Philippines. It is well known that the Philippine factories have been importing wrapper tobacco from Sumatra and other places in large quantities. The Tirona hybrid promises to supply this need and may thus become a new asset in the tobacco industry of the Islands.

We take the liberty of copying the following letter as written by the manager of the Germinal Company, Sr. Mauro Prieto.

COPIADO

Manila, P. I., Mayo 28 de 1915.

Sor. Jefe de la Estacion de Agricultura,

Los Baños, Laguna, P. I.

Muy Sr. Nuestro:—

Habiendo dado excelentes resultados los experimentos en la elaboración de cigarros con capas de la rama de tabaco que nos ha facilitado, procedente de la semilla mestiza ó cruce entre la semilla americana y la filipina, nos apresuramos á felicitarle por tan valioso descubrimiento que resuelve uno de los problemas que favorece á la industria tabacalera, y por tal motivo, agradeceríamos muchísimo se sirva facilitarnos de tal semilla en alguna cantidad abundante para sembrar en nuestra Hacienda de Maluno, Ysabela de Luzon, en donde acostumbramos a preparar los terrenos para este cultivo de Agosto á Septiembre de todos los años. La muestra que recibimos lleva una tarjeta con la siguiente inscripción: "TIRONA HYBRID—1st Clase—J. J. Mirasol."

Con las gracias anticipadas por esta atención y en espera de su atención á nuestro ruego con las semillas solicitadas, nos ofrecemos de V. respetuosamente.

"GERMINAL" Sociedad Anónima.

(Sgd.) M. Prieto,

Administrador Gerente.

mm. In the set under consideration (Set 6) the production per plant was 536 gm., as compared with the 320 gm. for Set 5, where the average growth was 101 mm.

2431 Reine des Hâtives had in Set 6 an average growth of 110 mm. The yield per plant was 235 gm. The plants of this variety in the previous sets had an average weekly growth of less than 100 mm., and did not bear fruit.

2384 Dessert had in Set 6 an average weekly growth of 112 mm. The yield for that set was 1489 gm. per plant, as compared with the 320 gm. per plant in Set 5, where the average weekly growth was 66 mm. per plant.

Conditions Governing Each Set, with Results

Set 1.—Planted November 29, 1913. The total rainfall was 3.87 inches during December, 0.61 inches in January, 0.36 inches in February, and 0.17 inches in March. It will thus be seen that the set existed in a period of drought. The plants were subjected to furrow irrigation, the furrows being immediately covered up after the water was run in and had soaked into the soil. In spite of this treatment, however, a number of the plants suffered, as seen from the curly, discolored, unhealthy appearance of the leaves and the slow stunted growth of the stems. The varieties that bore fruit were: 2384 Dessert—average, 50 gm. per plant; 2379 Golden Nugget—80 gm. per plant; 2377 Cascade—220 gm. per plant; and the Santa Cruz variety—90 gm. per plant. As will be noted, all the imported varieties that fruited in this set were of the small plum type. The explanation that may be offered for the success of this type, while the larger commercial forms failed, is that the plum type of tomatoes or those of the smaller forms are nearer the wild type, which has the capacity for struggling against adverse conditions. The larger commercial forms are more highly specialized and are therefore not so resistant, as those that more closely approach the wild variety.

Set 2.—Planted January 29, 1914. By referring to the table of rainfall, it will be noticed that this planting has been attended by a drought which was a prolongation of that against which Set 1 had struggled. The case in Set 2 was more severe because the previous months' condition of dryness had already caused a great part of the water content of the soil to evaporate, leaving the latter in a very dry condition. The intensity of the heat of the sun caused many of the plants to die. The following varieties bore fruit: 2384 Dessert—average, 30 gm. per plant; 2379 Golden Nugget—30 gm. per plant; 2377 Cascade—112 gm. per plant; and the Santa Cruz variety—80 gm. per plant.

Set 3. Planted March 30, 1914. The plants suffered from drought in the beginning and from heavy precipitation in June, when the rainfall for the month reached a total of 12.11 inches. The ground on which this set was planted was a low place and there were times when the roots were soaked by rain water. Due to these adverse conditions all except two of the imported varieties failed to set fruit. The two successful varieties were: 2384 Dessert—12 gm. per plant; and 2379 Golden Nugget—10 gm. per plant.

Set 4.—Planted May 29, 1914. The seedlings in the lathed nursery house were to some extent injured by the rain in June. Varieties 2381, 2387, 2428, 2429 and 2439 succumbed to the effect of the heavy precipitations. The following varieties bore fruit: 2441 Merveille des Marches—average, 129 gm. per plant; 2429 Prince Borghèse—149 gm. per plant; 2434 Roi Humbert—168 gm. per plant; 2384 Dessert—280 gm. per plant; 2382 Sunbeam—18 gm. per plant; 2379 Golden Nugget—40 gm. per plant; and 2377 Cascade—112 gm. per plant. The Santa Cruz variety yielded 72 gm. per plant.

Set 5.—Planted July 29, 1914. The heavy precipitation which occurred during the first half of September destroyed many of the plants. Only the following varieties produced fruit: 2384 Dessert—average 320 gm. per plant; 2436 Trophy, rouge grosse lisse—40 gm. per plant; 2441 Merveille des Marches—92 gm. per plant; 2426 Prince Borghèse—240 gm. per plant; and 2434 Roi Humbert—320 gm. per plant. The Santa Cruz variety yielded 172 gm. per plant.

Set 6.—First planting September 29, 1914. The ants became very numerous and carried all of the sown seeds away. Replanted October 8, 1914, this time supporting the boxes on legs that were submerged in kerosene. There were frequent moderate showers and rainfalls during the months following until January, when it gradually became dry. Conditions were very favorable to the plants and they grew vigorously and luxuriantly. The crops from different varieties in this set were much greater than in any previous planting. The following varieties gave fruit: 2384 Dessert—average, 1489 gm. per plant; 2382 Sunbeam—134 gm. per plant; 2379 Golden Nugget—616 gm. per plant; 2377 Cascade—865 gm. per plant; 2441 Merveille des Marches—155 gm. per plant; 2431 Reine des Hâtives—235 gm. per plant; 2433 Rouge grosse

hâtive—120 gm. per plant; and 2434 Roi Humbert—536 gm. per plant. The Santa Cruz variety had a yield of 285 grams per plant.

It will be seen from the above results with each set that the tomato, to be profitable, must be planted at a time when it will not be subject to severe drought. Heavy and continuous rainfall is, likewise, disastrous to the tomato.

The failure of the tomato to set fruit during the rainy season may be ascribed to at least two causes: First, the tomato suffers from "wet feet" and becomes diseased or too weak constitutionally to produce any fruit; second, rainy and cloudy weather is unfavorable to the opening of the anthers and to the action of the pollen. On the other hand, bright sunshine greatly enhances the effect of the pollen. Sandsten, formerly horticulturist of the Wisconsin Agricultural Experiment Station, found that at 33° C the rate of growth of the pollen tube of the tomato per hour was 45 mm. against 27 mm. during cloudiness(1).

To accomplish the best results the following varieties are recommended for planting on the dates indicated:

Between November 29 and January 29—2384 Dessert; 2379 Golden Nugget and 2377 Cascade.

Between January 29 and March 30—2377 Cascade.

Between March 30 and May 29—2379 Golden Nugget; 2384 Dessert; and, possibly, 2377 Cascade.

Between May 29 and July 29—2384 Dessert; 2377 Cascade; 2434 Roi Humbert; 2426 Prince Borghèse; 2441 Merveille des Marches; and 2379 Golden Nugget.

Between July 29 and October 8—2384 Dessert; 2434 Roi Humbert; 2426 Prince Borghèse; 2441 Merveille des Marches; and, possibly, 2436 Trophy rouge grosse lisse.

Between October 8 and November 29—2384 Dessert; 2377 Cascade; 2379 Golden Nugget; 2434 Roi Humbert; 2431 Reine des Hâtives; 2441 Merveille des Marches; 2382 Sunbeam; and 2433 Rouge grosse hâtive.

This will provide for a succession throughout the year.

Description of the Varieties that Fruited in the Test

2384 Sutton's Dessert.—Average height of plant, 70 cm.; stem, semi-robust; pubescence medium, fruit red, average 2 to 2.5 cm. in diameter, pointed at the blossom end, mildly acid, sweetish to the taste.

2379 Golden Nugget.—Average height, 60 cm.; stem, quite strong; pubescence medium; golden yellow, ovate, 2 to 3 cm. in diameter; acidity almost lacking.

2426 Prince Borghese.—Average height, 80 cm.; stem, weak; pubescence medium; fruit red, oblong, suggestive of the shape of a straight cucumber; in length, 4 cm. to 6 cm.; 2.5 cm. to 3 cm. in diameter; flavor, mildly acid, sweet.

2434 Roi Humbert.—Average height, 75 cm.; stem, semi-robust; pubescence medium; fruit red, oblong, almost elliptical, blunt at the two ends, 4.5 to 5 cm. long, 3 cm. to 3.5 cm. in diameter; sweet, slightly acid.

2377 Cascade.—Average height, 50 cm.; stem, small and weak; pubescence scanty, almost absent; habit, spreading; fruit red, spherical, 1 to 1.5 cm. in diameter, similar to that of the wild type, only more firm; acid.

2382 Sunbeam.—Average height, 70 cm.; stem, fairly strong; pubescence medium; fruit globular, golden yellow, 3.5 to 5 cm. in diameter; flesh firm, sweet, slightly acid.

2436 Trophy, Rouge Grosse Lisse.—Average height, 1 meter; stem rather weak; pubescence medium; constitution, very poor; fruit bright crimson, 3 cm. to 3.5 cm. in diameter, mildly acid.

2441 Merveille des Marches.—Average height, 1 m.; stem, fairly strong; pubescence medium; fruit yellowish red, globular, 5 cm. to 7 cm. in diameter; very firm and fleshy, slightly acid. (A promising variety for eating fresh and for canning purposes.)

2431 Reine des Hatives.—Average height, 75 cm.; stem fairly strong; pubescence medium; fruit bright red, flatly globose, 4 cm. to 5 cm. in diameter, mildly acid.

2433 Rouge Grosse Hative.—Average height, 80 cm.; stem fairly strong; pubescence medium; fruit red, globular, 4 cm., to 5 cm. in diameter, slightly acid.

Summary of Acclimatization Tests

1. Tomatoes, in this region on ordinarily level ground, are most profitable only when sown between July and October and, possibly, the earlier part of November. Tomatoes planted in other seasons need special care and are likely not to bear any fruit.

2. Of the thirty-two imported varieties, only eight could be made to bear fruit in some season. Of these eight, three are of the commercial type, and five of the small fancy types. The showing for these successful varieties was fair, considering the fact that this is the first time they have been tried in this country. Seed selections have been made from the healthier plants. It is expected that future generations

(1) Wisconsin Agr. Exp. Sta., Research Bull. No. 4.

will give better results as acclimatization proceeds.

3. The smaller fancy types were more successful than the large commercial varieties, apparently because the former approach the wild type more closely and, therefore, are hardier and better equipped to resist adverse conditions than the more highly specialized commercial forms.

4. It was found that the tomatoes raised from seeds imported from France did better in this region than those from seeds imported from England. The apparent reason for this is that the former is a more southern country.

5. Due to the requirements of the plants in the way of intensive cultivation, it is not advisable to raise tomatoes on a large scale unless a large amount of labor, properly handled, is available.

6. A period of prolonged drought and, likewise, a period of heavy and continuous rainfall will cause failure to set fruit.

7. A long rainless period retards growth on the characteristicly porous soils of the College farm, in spite of occasional irrigation.

8. A period of sunshine following a period of rainfall results in an increase in the rate of growth.

9. A period of continuous heavy rainfall retards growth.

10. A period of light rainfall following a period of sunshine results in an increase in the rate of growth.

11. The season of the most rapid average growth of a variety is the season in which that variety will have the greatest field yield in fruits.

Experiments With Different Methods of Stem Training

Local farmers allow tomato plants to grow freely and sprawl about over the ground, in marked contrast with garden practice in the United States, where the plants are, as a rule, grown on supports, in the form of either stakes, trellises, or frames. The stem is trained to one, or two, or three stems and in many cases, allowed to grow freely on the support. The reason for training and supporting the plants is that this mode of treatment prevents whipping and attack by insect and fungous pests.

It was found by W. H. Wicks(1), of the Idaho Agricultural Experiment Station, that tomatoes pruned to one stem gave the smallest number of culls; while plants receiving no pruning at all had the largest number of culls.

(1) Idaho Agr. Exp. Sta. Bull. 76.

G. C. Temple(1), of the Georgia Agricultural Experiment Station, found that all plants pruned and staked gave a higher yield than others. His staked plants had a bearing season twice as long as the rest. It was found by the same experimenter that the fruits of the staked plants were larger and freer from defects than the rest; he was, however, not in a position to recommend the exclusive use of stakes. In one of his trials he found that his poorest yields were from staked plants, the fruits of which showed a greater percentage of diseased specimens. He also found from his work conducted during the year 1911, when he was experimenting with the control of blossom-end rot, that the unstaked plants had a smaller percentage of affected fruits than those staked.

Whether or not growing the plants on a support will pay in the Philippines and what kind of a support may best be employed has been investigated in the following experiments:

Thirteen plots were used, each containing forty-eight plants of the same age. These were apportioned as follows:

Plot 1. Plants pruned to a single stem and staked.

Plot 2. Plants pruned to a single stem and trained on trellis.

Plot 3. Plants pruned to a single stem and allowed to lie unsupported on the ground.

Plot 4. Plants pruned to two stems and staked.

Plot 5. Plants pruned to two stems and trained on trellis.

Plot 6. Plants pruned to two stems and allowed to lie unsupported on the ground.

Plot 7. Plants pruned to three stems and staked.

Plot 8. Plants pruned to three stems and trained on trellis.

Plot 9. Plants pruned to three stems and allowed to lie unsupported on the ground.

Plot 10. Plants unpruned and staked.

Plot 11. Plants unpruned and trained on trellis.

Plot 12. Plants unpruned and allowed to lie unsupported on the ground.

Plot 13. Plants pruned to bush form.

For stakes and trellises the materials used were bamboo and abacá sheath for tying. The laborer employed in making the stakes could turn out a minimum of one hundred stakes in a working day of eight hours. The same stakes were used for the supporting poles of the trellises. Three cross pieces of bamboo were all that were required for every row of four plants in addition

(1) Georgia Exp. Sta. Bull. 96.

to the poles in the plots where a trellis was used. The dry abacá sheath was also used in tying the tomato stems to their supports.

For placing the stakes and the trellises in place and for tying the stems, student labor was used. It was found that a student laborer can stake a plot of forty-eight plants in from thirty to forty minutes; it takes about one and a half times as long to make the trellis.

The results are embodied in Table III.

TABLE III.

EXPERIMENTS ON STEM TRAINING: YIELD PER PLOT

Plot.	*Marketable Fruits*		*Damaged Fruits*		*Total Yield*		*Loss %*	*Av. Wt. of Fruits Grams*	*First Harvest*		
			Grams	*No.*	*Grams*	*No.*			*Date*	*Grams*	*No.*
1	830	17	150	4	980	21	23	48	9-II	90	2
2	3360	69	240	3	3600	72	4	48	3-II	490	6
3	4060	90	970	17	5030	107	18	45	3-II	180	3
4	5160	72	800	18	5960	90	25	71	3-II	310	3
5	10390	165	950	17	11340	182	10	63	3-II	320	4
6	7890	182	1290	24	9180	208	13	43	3-II	170	3
7	4680	142	265	6	4945	148	4.2	33	3-II	120	4
8	6680	147	640	13	7320	160	9	45	3-II	50	1
9	9940	206	580	10	10520	216	5	48	9-II	850	10
10	10510	162	860	19	11370	181	12	64	3-II	270	3
11	10110	149	2570	19	12680	168	12	67	3-II	90	2
12	12000	190	1800	26	13800	216	14	63	3-II	200	3
13	10310	158	1860	32	11170	180	20	65	3-II	100	1

From an inspection of the results presented in this table the following conclusions may be drawn:

1. Leaving the plants unpruned and allowing them to grow without a support will give better results in this locality in the way of increasing the yield in marketable fruits. Those that were pruned to two stems and trained on a trellis gave the second largest yield.

2. Pruning to one stem and staking, results in diminishing the yield in marketable fruits.

3. The largest total yield (marketable and damaged fruits combined) was obtained by allowing the plants to go untouched by the shears and untrained.

4. Plants pruned to a single stem and supported on a trellis had the smallest percentage of damaged fruits.

5. Plants pruned to two stems and staked had the largest percentage of damaged fruits.

6. Pruning to a single stem and training on a trellis caused an early maturing of the fruits; to two stems on a trellis, the second earliest.

7. Pruning to a single stem and staking, to three stems on the ground, and to three stems on a trellis had a tendency to retard the maturity of the fruits.

8. The largest average weight of individual fruits was obtained by pruning the plants to two stems and staking the second largest, from allowing free growth and training the plant on a trellis and the third, from pruning the plant to bush form.

9. The smallest average weight of individual fruit was obtained from pruning the plants to three stems and staking.

EXPERIMENTS WITH FERTILIZERS

Nitrogen is required by the tomato for the formation of leaves and stems. Enough of this element must be present in order that a sufficiently strong stem may be formed to support the large fruits and that the foliage may develop to such an extent as to enable the plant to carry on its normal functions of life without any check. Too much nitrogen, however, is not advisable due to its tendency to encourage excessive growth of vine at the expense of fruit.

Phosphorus is necessary mainly for the production of seeds and is also an important constituent of the cell protoplasm.

Potash is present in all the parts of the plant. It has an important role in plant assimilation and is the principal component of protoplasm. It is essential to the formation of the acid in the tomato fruits, and its existence in abundant quantity in the soil is essential to success in tomato culture.

The scheme of the present experiments is modeled after the recommendation of Prof. L. C. Corbett in *Farmers' Bulletin* No. 220, U. S. Dept. of Agr. Twelve plots, 5 m. × 13 m.

were used, each containing forty-eight plants at a distance of one meter each way. The fertilizers or combinations of fertilizers experimented with are enumerated below. The fertilizers were applied by digging a trench for a distance of about two decimeters around each plant, applying the fertilizer, copiously watering the trench and subsequently covering it up. In addition, a plot was treated with lime.

Behn, Meyer and Co. of whom the fertilizers were obtained, furnished the following data as to percentage of active elements:

Nitrate of soda, 15% nitrogen.
Chloride of potash, 40% to 49% potassium.
Double superphosphate, 40% phosphorus.
Single superphosphate, 20% phosphorus.
Sulphate of potash, 40% to 48% potassium.

The plan of the experiment is as follows:

Plot 1. Sodium nitrate, 1 kilo.

Plot 2. Chloride of potash, 1 kilo.

Plot 3. Double superphosphate, 4 kilos.

Plot 4. Single superphosphate, 4 kilos.

Plot 5. Nitrate of soda, 1 kilo; chloride of potash, 1 kilo.

Plot 6. Chloride of potash, 1 kilo; single superphosphate, 4 kilos.

Plot 7. Nitrate of soda, 1 kilo; single superphosphate, 4 kilos.

Plot 8. Nitrate of soda, 1 kilo; single superphosphate 4 kg.; chloride of potash, 1 kilo.

Plot 9. Sulphate of potash, 1 kilo.

Plot 10. Carabao dung, 1 shovelful per plant.

Plot 11. Lime, 20 kilos.

Plot 12. Control: No fertilizer.

The results are summarized in Tables IV and V.

TABLE IV.

EXPERIMENT ON FERTILIZERS: AVERAGE GROWTHS PER WEEK

Week Ending.	*Plot 1 mm.*	*Plot 2 mm.*	*Plot 3 mm.*	*Plot 4 mm.*	*Plot 5 mm.*	*Plot 6 mm.*	*Plot 7 mm.*	*Plot 8 mm.*	*Plot 9 mm.*	*Plot 10 mm.*	*Plot 11 mm.*	*Plot 12 mm.*
19-XII-14.....	117	103	131	94	115	101	139	120	119	133	110	127
26-XII-14.....	118	135	169	142	153	201	167	165	148	164	129	159
2- I-15.....	93	98	172	135	170	218	112	118	145	163	104	140
9- I-15.....	75	103	188	85	121	157	149	72	101	106	92	137
Gen. Av.....	101	110	165	114	139	169	142	119	128	141	109	141
Fertilizers:	$NaNo_3$	KCl	$Ca_2H_2(Po_4)_2$	$CaH_4(Po_4)_2$	$NaNo_3$ + KCl	KCl + $CaH_4(Po_4)_2$	$NaNo_3$ + $CaH_4(Po_4)_2$	$NaNo_3$ + $CaH_4(Po_4)_2$ + KCl	K_2So_4	Carabao dung	Lime	Control

TABLE V.

EXPERIMENT ON FERTILIZERS: YIELD PER PLAT

Plat	*Marketable Fruits Grams*	*No.*	*Damaged Fruits Grams*	*No.*	*Total Yield Grams*	*No.*	*Av. Wt. of one Fruit*	*First Harvest (3-II-15) Grams*	*No.*	*Fertilizers*
1	3820	119	920	22	4740	121	32	10	1	$NaNo_3$
2	7920	218	1065	33	8985	251	36	680	9	KCl
3	8830	202	1450	31	10280	233	43	210	5	$Ca_2H_2(Po_4)_2$
4	13150	222	2730	50	15880	272	59	370	7	$CaH_4(Po_4)_2$
5	13490	247	2161	45	15651	292	54	970	13	$NaNo_3$ + KCl
6	16660	319	2640	59	19300	378	52	300	4	KCl + $CaH_4(Po_4)_2$
7	9910	227	2440	47	10350	264	44	100	3	$NaNo_3$ + $CaH_4(Po_4)_2$
8	11540	239	4590	78	16130	317	48	470	8	$NaNo_3$ + $CaH_4(Po_4)_2$ + KCl
9	13730	275	2920	64	16650	339	49	290	6	K_2SO_4
10	19180	251	3720	72	22900	323	80	730	6	Carabao dung
11	16960	334	4570	79	21530	411	50	590	7	Lime
12	12000	190	1800	26	13800	216	63	200	3	Control

From the results presented in these two tables the following conclusions may be drawn:

1. Carabao dung is the most satisfactory of all the fertilizers used, from many standpoints.

It nearly doubles the total yield of the tomatoes, increases the yield in marketable fruits, and compares favorably with the more expensive forms of commercial fertilizers in hastening the maturity of the fruits.

It has the property of holding moisture in the soil. This may be taken as one of the reasons for the success with carabao dung in fertilizing the tomato, which is to some extent a plant of the dry season.

There is no danger in overdosing the plants by its use; in fact, the greater the application, the better the result is likely to be.

Carabao dung is commonly allowed to go to waste in this country and therefore can be had for practically nothing.

2. Many forms of commercial salts are unsatisfactory, and even dangerous, for use as fertilizers with the tomato plant. The tomato being a plant for the dry season, overdosing the plants will be disastrous; and it is hard to determine in an excessively dry season just what quantity will be safe. The danger may be minimized by making use of a generous supply of irrigation water; but a too abundant supply of water is just as fatal to the tomato plant (see experiment on irrigation). It will, therefore, be advisable to use commercial salts sparingly as fertilizers. The deficiency of plant food in the soil may in the case of the tomato be supplied with organic manures.

3. Liming is beneficial to the tomato; it increases the yield, both total and marketable, being second only to carabao dung in influencing the plants to yield a bigger crop. It also compares quite favorably with other fertilizers in hastening the maturity of the fruits. The only possible objection to its use is that it appears to have a tendency to decrease the size of the fruits. Its use should not be continuous on the same ground.

4. The fertilizers that have a tendency to hasten the maturity of the fruits are: Chloride of potash, alone, or in combination with nitrate of soda; carabao dung; and lime.

5. Chloride of potash, in combination with single superphosphate, increases the growth of the tomato plants more than does any other fertilizer or combination of fertilizers.

Irrigation Experiments

The tomato is too delicate a plant to endure very great dryness of the soil. The ground ought to be always moist (but not wet, as this condition is conducive to disease or weakness of the plants(1). During extremely dry seasons in the Philippine Islands the soil always becomes dried out and the development of the plants is seriously retarded.

The object of these experiments is to find out to what extent judicious irrigation increases the productivity of the tomato and to what extent the plant is injured by excessive irrigation. The effect of irrigation on the growth of the plant had been carried out from January 24, 1914, to March 28, 1914, but no record of the yield was kept, due to the fact that before the plants could bear fruit, the ground had to be used for other purposes. The growth record was a comparison of the rate of weekly increase of unirrigated and irrigated plants.

Experiments for comparing the yields of unirrigated, overirrigated, and of judiciously irrigated plants were again conducted within a period from the 8th of October, 1914, to the 20th of February, 1915. The plan of the experiment is as follows:

Plot 1. Control: Unirrigated.

Plot 2. Irrigated by running furrows at each side of the plant and applying just enough water to keep the roots moist. The furrows were then covered up immediately. This was done every other week.

Plot 3. Ground soaked once a week until thoroughly wet and cultivated with a hand cultivator on the second day, or when the soil ceased to be sticky.

The results of these tests are given in Tables VI and VII.

TABLE VI

Experiments with Irrigation: Average Growth per Week

Date	*Irrigated mm.*	*Unirrigated mm.*
31- I-14	35	24
7- II-14	65	48
14- II-14	96	67
21- II-14	79	64
28- II-14	79	73
7-III-14	67	44
14-III-14	49	41
21-III-14	37	24
28-III-14	31	23
General Average	54	45.

(1) Bull. 239, Univ. of Calif. Agr. Exp. Sta.

TABLE VII.

EXPERIMENTS ON IRRIGATION: RECORD OF YIELD

Plot	Marketable Fruits		Damaged Fruits		Total Yield		Av. Wt. of Fruit	First Harvest		
	Grams	No.	Grams	No.	Grams	No.		Date	Grams	No.
1 (unirrigated).....	8530	197	1980	30	10510	227	43	3-II-15	0	0
2 (irrigated).....	20780	424	4050	68	24820	492	49	3-II-15	600	7
3 (overirrigated).....	7180	129	1560	20	8740	149	55	3-II-15	270	3

It is evident that irrigation greatly increases the yield, increases the size of the fruits and hastens their maturity; heavy irrigation diminishes the yield, hastens maturity of the fruits to a limited extent and greatly increases the size of the fruits. But the first point is seriously against heavy irrigation, notwithstanding the fact that the other two points are in its favor.

SEED BED METHODS AND EFFECT OF EARLY AND LATE TRANSPLANTINGS

Preparation of the Seeds.—The selected ripe fruits are cut open and the seeds pressed out into a vessel, where they are allowed to stand for about eighteen hours. This is done in order to bring about the fermentation of the jelly-like mass which adheres to the seeds and which is extremely difficult to remove when fresh. The seeds are then washed clean, dried thoroughly and stored in moisture-proof receptacles. Seeds handled in this manner retain their vitality for a long time. The stock Santa Cruz seeds that have been used in all of the present experiments were secured in November, 1913, contained in cork-stoppered bottles. They had then been kept for about one year, and were, therefore, about two years old at the time of experimentation. A test showed that they gave sixty per cent germination.

Seed Bed Methods.—The native practice is to work a small area of land in one corner of the field, thoroughly pulverizing the soil and shaping the bed in such a way as to have the middle parts higher than the sides. This is done in order to prevent rain water from soaking the roots of the seedlings. A sloping place or the side of a hill will answer the same purpose. The farmers in this locality do not, as a rule, prick off their seedlings into nursery flats, but allow them to remain in the seed bed and then transplant them when they are large enough.

The following experiment was conducted to determine whether pricking off is beneficial to the tomato seedlings, and if so, to what extent:

Seeds were planted October 8, 1914, in a seed bed, and these germinated October 13 to 15, 1914. A part of the seedlings were pricked off into nursery flats while the other part was allowed to remain. The following results were obtained (see Table 8):

1. Pricked off seedlings grew vigorously and developed much faster than those that remained in the seed bed. The pricked off seedlings were ready to transplant on the 6th of November, while those that remained unpricked were not ready until the 13th of December.

2. Seedlings not pricked off were spindling and the color was not so vivid as that of those pricked.

3. Unpricked seedlings were infested with cutworms (*Plusia sp.*), that ate off most of the leaves and left many of the seedlings bare. The pricked seedlings, which lay just two decimeters from the seed bed, were free from pests.

4. In transplanting the seedlings to the permanent field, it was found that with unpricked seedlings the loss was 75 per cent in most cases, while the pricked ones had a maximum loss of only 10 per cent from the effect of the sun's heat.

5. The earliness in bearing and the amount of yield are very much affected as a result of letting the seedlings remain unpricked. The first harvest in pricked plants transplanted November 6, 1914, was on the 27th of January, 1915, amounting to 155 gm. per plot (Table 8 Plot 1); that of the unpricked, transplanted December 13, 1914, was on February 17, 1915, or about a month later, amounting to only 80 gm. per plot (Table 8, Plot 4).

6. Pricked plants and those that have not been pricked, both transplanted on the 13th of December, 1914, had a total yield of 3,050 gm. in favor of the former against the total of 180 gm. of the latter (Table 8, Cf. Plots 3 and 4).

7. The first harvest of the pricked plants set at the same time as the unpricked was 600 gm.; that of the unpricked, 80 gm. (Table 8, Cf. Plots 1 and 4). This shows that the unpricked plants have a later fruit maturity than those pricked, even though they be planted at the same time.

TABLE VIII.

EXPERIMENTS IN TRANSPLANTING: RECORD OF YIELD

Plot	*Marketable Fruits*		*Damaged Fruits*		*Total Yield*		*Av. Wt.*	*First Harvest*		
	Grams	*No.*	*Grams*	*No.*	*Grams*	*No.*	*of Fruit*	*Date*	*Grams*	*No.*
1	11145	444	2530	82	13675	526	26	27- I-15	155	3
2	12000	190	1800	26	13800	216	60	3-II-15	200	3
3	3000	51	50	4	3050	55	58	17-II-15	600	7
4	180	32	—	—	180	32	6	17-II-15	80	1

EXPLANATORY NOTE:—Seeds planted October 8, 1914, and
Plot 1 was pricked, and transplanted November 6;
Plot 2 was pricked, and transplanted November 20;
Plot 3 was pricked, and transplanted December 13; and
Plot 4 was unpricked, and transplanted December 13.

A study of the effect of early and late transplanting (Table VIII) gave the following results:

1. Allowing the seedlings to remain in the seed bed without pricking off results in the following disadvantages:

Retarding of the development of the plants.

Weakness of the stem and general debility of the plant.

Susceptibility to insect attacks while in the seed bed.

A larger percentage of failures in transplanting.

Lateness in the maturity of the fruits.

Inferiority of the harvest to that of the pricked plants, both in size of fruits and in quantity.

2. Pricking off has the following advantages:

It promotes a constitutional vigor and encourages a faster development of the seedlings.

The seedlings are less susceptible to attacks of disease.

Fruits mature earlier and crops are bigger.

3. The plants must be transplanted at about the twenty-ninth to the forty-third day from the date the seeds are planted. Further delay will result in lateness in the maturity of the fruits and a great reduction of the yield.

Effects of Partial Shading.—The severe drought which attended the setting of tomatoes planted on the 29th of November, 1913, suggested the idea of partially shutting off the sun's rays in the belief that this means would promote a greater productivity. A plot was set apart, a frame built over it and a sparse cover of dry coconut leaves, calculated to shut off about fifty per cent of the light, was arranged thereon. The outcome was far from encouraging, for the plants grew tall and spindling, the leaves were thin and were not so green as in the open, and no fruit was harvested.

INSECT PESTS

There are not many species of tomato insects in this locality; but there are times when members of one or more species become so numerous as to cause serious trouble. In the pages which follow an account is given of the insect pests of the tomato observed at the College of Agriculture and neighboring places:

Twenty-eight Spotted Lady Beetle (*Epilachna 28-punctata*).—This insect belongs to the family Coccinelidae, and is a reddish-brown beetle, about 3 mm. in length. The elytra and the pronotum bear black dots, altogether numbering twenty-eight, hence the specific name. Plants from two to three weeks in the permanent field were found to be most susceptible to the attacks of this insect. There were times when the insects were present in great numbers, skeletonizing the leaves, and chewing of the bark off the stem, till the plant finally succumbed to their depredations.

The life history may be observed from the following breeding record:

24-X-14	copulation.
25-X-14	eggs laid.
29-X-14	eggs hatched.
31-X-14	larva first molted.
16-XI-14	pupated.
20-XI-14	adult emerged.

The eggs were yellow, elliptical, pointed and laid in a mass of about twenty-four. They hatched in four days into minute blackish-brown larvae, which soon begin to feed voraciously on the surface of the leaves and soft stems.

As the larvae grew larger with each ecdysis, the destruction they wrought on the plants increased proportionately. The larvae changed their original color to that of a yellowish tint in the second instar. The first instar lasted two days; the second to fourth sixteen days,

and after the fourth, the larvae passed to the pupal stage, in which condition they remained for four days. The adults then emerged, and after about six hours resumed eating the succulent parts of the tomato plant with renewed vigor.

Paris green at the rate of 1 lb. per 50 gal. has proven effective against these pests.

Tomato Fruit Worm (*Heliothis Armigera Hübn*).—This insect belongs to the family Noctuidae, which includes many destructive plant enemies. They were abundant in the tomatoes in Set 5 (planted July 29, 1914), the larvae destroying about fifty per cent of the season's crop.

The caterpillar has the habit of boring a hole into the rind of the fruit and eating a portion of the flesh, making a home inside until the fruit ripens. Sometimes it comes out even before that time and bores a hole into another fruit. Thus, a single caterpillar is able to injure several fruits before it passes to the pupal stage. The wound made sometimes heals; but decay very often sets in and the whole fruit becomes damaged.

The following is a part of the life history of the insect:

9-I-15	larva collected.
10-I-15	larva molted for the last time.
14-I-15	larva went into ground (1:45 P. M.)
15-I-15	pupated.
25-I-15	adult emerged.

No eggs have been secured in order to complete the cycle of the insect's life history. The last instar in the larval stage lasted four days. The caterpillar then went into the ground and pupated. The pupal stage lasted ten days. The adult is pale olive-colored moth, about 1.2 cm. long.

It was difficult to exterminate the pest with Paris green, as most of what it eats comes from the interior of the fruit. Hand picking controlled the pest to some extent.

In addition to the tomato fruit, the caterpillar also attacks corn, and even prefers this plant to the tomato. Watson(1) recommended, as a preventive measure, the planting of two rows of sweet corn for every twenty-five rows or so of tomatoes, setting the time of planting at such a date as will enable the corn to begin to tassel just as the tomatoes begin to be attractive to the worms. The infested catch-crop of corn can then be fed to cattle before the adult insect emerges and flies out, and in this way the damage may be minimized.

(1) Bull. 112, Univ. of Fla. Exp. Sta.

Cut Worms (*Plusia sp.*).—The caterpillar is the larva of *Plusia* sp., a small brown moth which belongs to the family Noctuidae. It is especially destructive to the young seedlings in the seed beds and to those newly recovering from wilt, due to the effect of transplanting. Sometimes the older plants are also attacked, but the injury done is not great.

No remedial measure has been experimented with in connection with this particular pest. Cocoons of a small hymenopterous parasite have been found occupying the whole interior of the body of a dead caterpillar, of which several were found. The parasite is undoubtedly very helpful in keeping the pest in check in this locality.

Stem Borer.—This pest has not been found in the tomato plants grown in the College of Agriculture; but was quite abundant in Calamba and in Santa Cruz, La Laguna. The insect is probably identical with the fruit worm (*Heliothis armigera* Hübn). The larva eats into the stalk and lodges there until it is ready to pupate, when it descends into the ground and buries itself there.

The affected plant becomes stunted in growth and the leaves are deformed.

Thrips.—Thrips became numerous during the months of October and November, 1914, and their presence was noticeable by the sickly yellowish aspect of the leaves, which on microscopical examination revealed the minute insects crawling about over the hairs. Several plants have died from their attack.

Nezara Viridula, Linn.—A pentatomid bug with nymphs that are at first black and have four rows of white spots running along the back. After at least two moltings the color changes to delicate green with four rows of white spots running along the back. The adult is about 1 cm. long, and green.

The insect causes unsightly white blotches to appear on the ripe fruit due to the effect of its sucking. It has a habit of congregating, sometimes ten or twenty being present on a single fruit, robbing it of its juices and deforming it. The injury done in the cultures at the College was not very great.

Mealy Bugs, (Pseudococcus sp.).—Family Coccidae. Insects about 2 mm. long, present on stems and under sides of the leaves. The body is covered with a waxy coating, which aids it in evading destruction by natural enemies. They have not been present abundantly enough to become a menace; but if ever they do become so, their social habits will make them easy to control with kerosene or carbolic acid emulsion, or other contact insecticides.

Ants.—Ants of different species proved very troublesome in seed beds in the plantings of October 29 to November 29, 1914, stealing most of the seeds before they germinated and storing them away in their nests. Certain species attack the ripe fruit when it comes in contact with the ground, eating off the skin and a portion of the flesh, and rendering the fruit unsalable.

When ants are found to be troublesome in seed beds, it will be more practicable to plant in boxes instead of in the ground. The boxes can then be supported on legs which can be immersed in kerosene to keep the ants away. In places where ants are known to attack fruits, the plants should be supported on trellises. Fruits kept away from the ground are seldom molested by ants.

Cockroaches.—Like the ants, there is a small species of cockroach, *Phyllodromia sp.*, which eats the ripe fruits that come in contact with the ground. The injury done on the whole, however, is not great.

The Tomato-Leaf Bug.—This is a small green bug, about 1.5 mm. long, belonging to the family Miridae (Capsidae). The insects are found quite abundant, running actively along the stems and leaves. It is not positively known to what extent the injury to the plant is done, as the plants do not seem to show any sign of inconvenience from their presence.

Diseases

Fruit Rot.—There are a number of organisms which cause the decay of fruits, the most common of these being *Macrosporium, Alternaria solani, Diplodia,* and several molds. The decay very often has its origin in an infection from the punctures of sucking insects; or the germs and molds of decay may be carried into some crack in the fruits or in weak parts of badly formed tops of fruits. Rot seldom occurs on smooth and perfectly formed fruits. In the Santa Cruz tomato, which is ridged and formed in any odd shape, the loss due to decay was in certain cases more than fifty per cent of the total harvest. The more perfectly round fruits of the imported varieties, the small fancy types as well as the commercial, were almost free from rots.

All the fruits that show signs of decay must be picked immediately and burnt in order to prevent further contamination. Spraying once a week with Bordeaux mixture was found to greatly reduce the loss due to fruit rot. An allied disease, known as blossom-end rot, was found by Stuckney and Temple to be controlled, if not entirely prevented, by keeping an abundant supply of water in the soil(1).

Root Knot.—This disease is charaterized by excessive enlargements in the form of knots all over the roots. Affected plants at once become stunted, the leaves become thick and crumpled, and they soon die. The cause is a small nematode worm, of the genus *Heterodera,* which lives in the roots and draws its nourishment from the plant tissues. Infestation of this kind was especially abundant in the plantings between November, 1914, and January, 1915, in some of the fields. Places known to be infested with *Heterodera* should not be planted with tomatoes, potatoes, or other solanaceous plants for a period of at least two years.

Tomato Wilt.—The disease known as tomato-wilt has quite commonly been met with during the progress of the tomato experiments, and is doubtless the same as that found by E. F. Smith to be caused by a certain bacterium which he named *Bacillus solanacearum.* The attacked plants show signs of wilting and curling of the leaves, followed by blotches on the stem. "The browning of affected parts is characteristic of the presence of the bacterium; the browning will be first evident in the vascular ring on examining the cut surface of an affected stem. The vascular bundles are first affected, the supply of water to the leaves is checked and the consequent wilting or shriveling makes its appearance(2)."

J. A. Honing pointed out that *Bacillus nicotianae* Uyeda, which attacks the tobacco plant, is identical with *B. solanacearum* Smith(3). On one small plot on the College Farm this year all the tobacco plants died of wilt. The plot was then cleared out, prepared, and tomatoes were planted in the same place. The result was that all except three of the plants also died of wilt. It is, therefore, to be noted that the tomato should *never* be planted on land where tobacco has been found to die of wilt, within two years, at least.

Fruit Cracking.—This malady has damaged many of the fruits in Set 5 (planted July 29, 1914), the plants having been grown in a season when the ground was appreciably moist from the previous rainy season, while the atmosphere was dry. This is not caused by any organism; but is rather a physiological derangement. It is caused by the existence of conditions favorable to root absorption while there is present a factor which hinders the growth of the fruit skin. For this reason, a dry season suddenly followed with a heavy rain results in the cracking of very many fruits.

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(1) Georgia Agr. Exp. Sta. Bull. 96.
(2) Agr. Bull. Str. and Fed. Malay States, Vol. IX, No. 12, p. 478.
(3) Rec. Trav. Bot. Néerland, Vol. X, No. 2, pp. 85-136.

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